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Hsu

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(54) **VARISTOR DEVICE**

(71) Applicant: **POWERTECH INDUSTRIAL CO., LTD.**, New Taipei (TW)

(72) Inventor: **Jung-Hui Hsu**, New Taipei (TW)

(73) Assignee: **POWERTECH INDUSTRIAL CO., LTD.**, New Taipei (TW)

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H01C 1/144 (2006.01)
H01C 7/102 (2006.01)
H01C 7/12 (2006.01)

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(58) **Field of Classification Search**
CPC H01C 1/144; H01C 7/102
USPC 338/21
See application file for complete search history.

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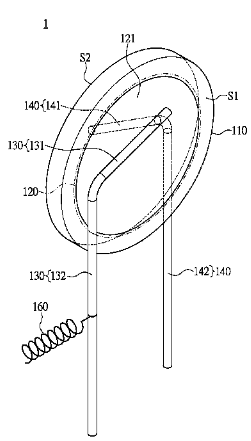
Primary Examiner — Kyung Lee

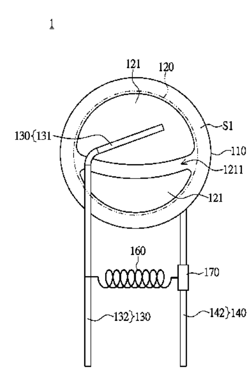
(74) *Attorney, Agent, or Firm* — Li & Cai Intellectual Property (USA) Office

(57) **ABSTRACT**

A varistor device includes a main body, a conductive area, a specific-melting-point metallic pin, and an elastic unit. The main body has a first surface, and the conductive area is located at the first surface. The specific-melting-point metallic pin has a first section and a second section. The first section and the second section are one-piece formed. The first section is fixedly disposed on the conductive area. The second section has a specific melting point such that the second section melts when a current flows between the first surface and the second section so as to expose the second section to a temperature greater than the specific melting point. The elastic unit has an end connected to the second section, and the elastic unit provides an elastic force to the second section to break the second section so as to cut off the current when the second section melts.

7 Claims, 15 Drawing Sheets





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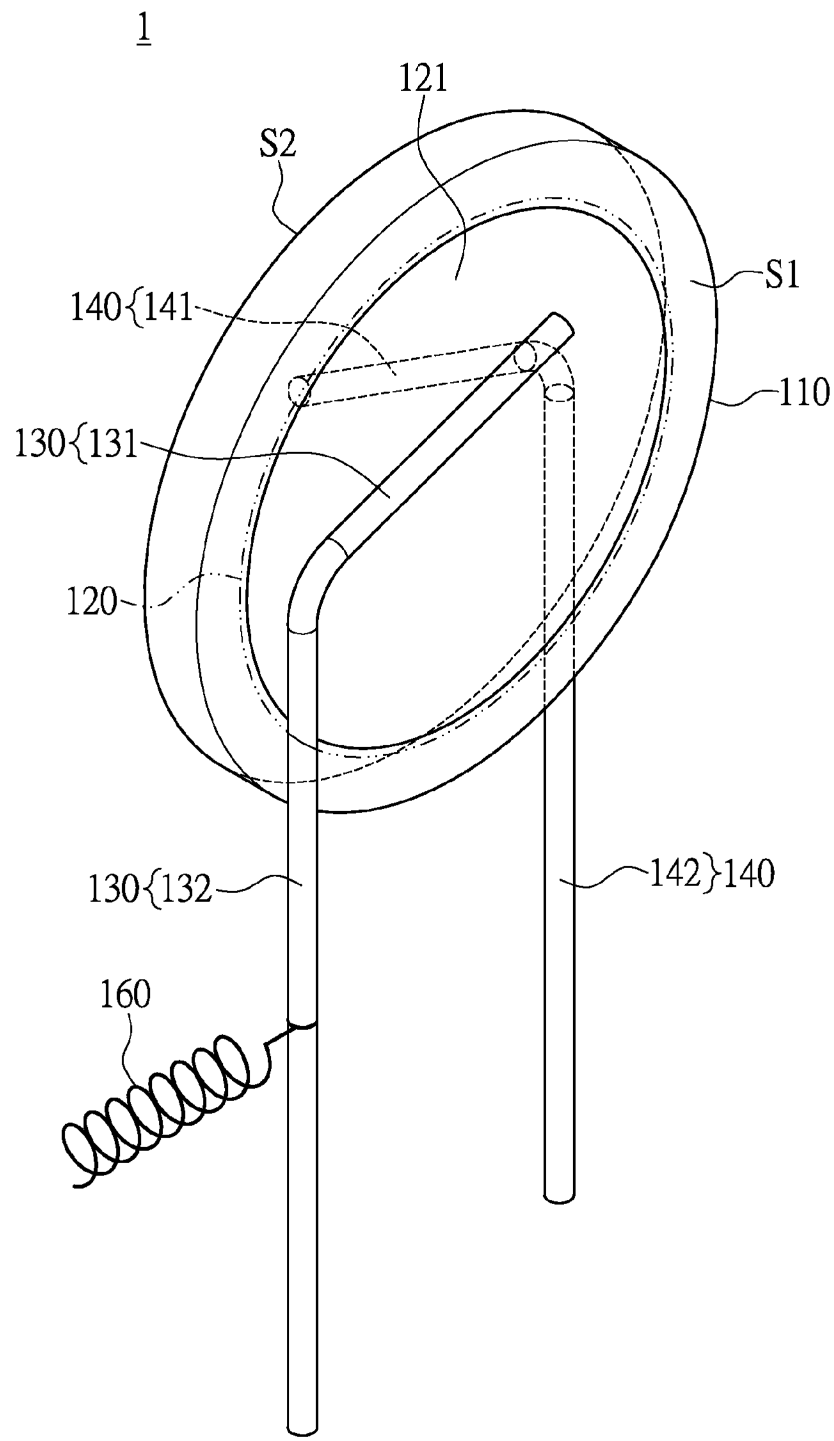

FIG.1

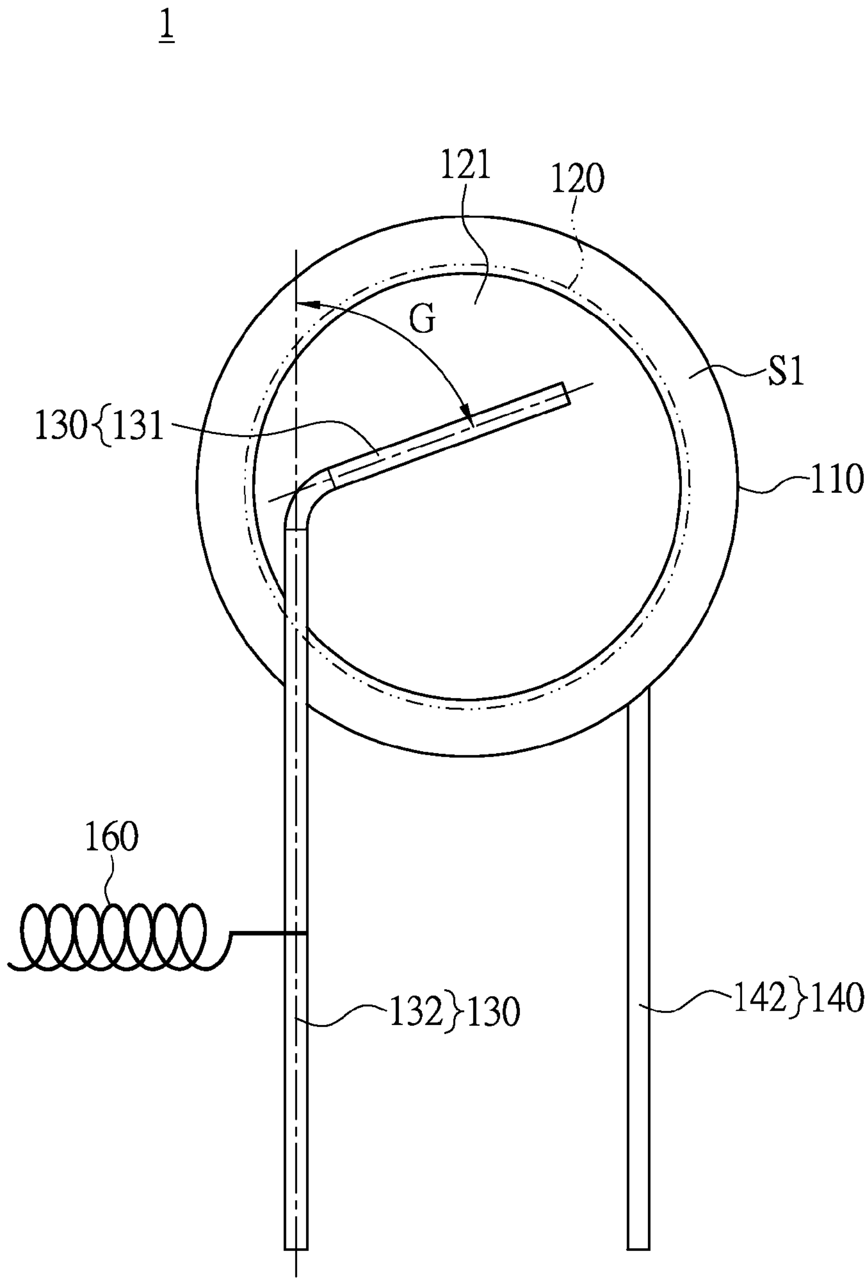

FIG.2

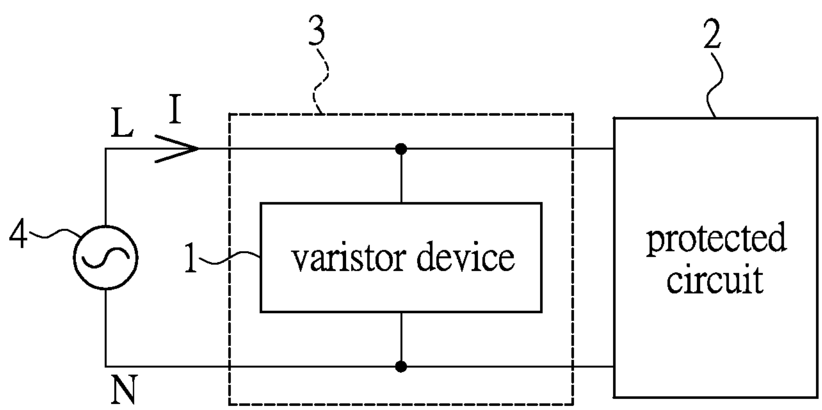

FIG.3

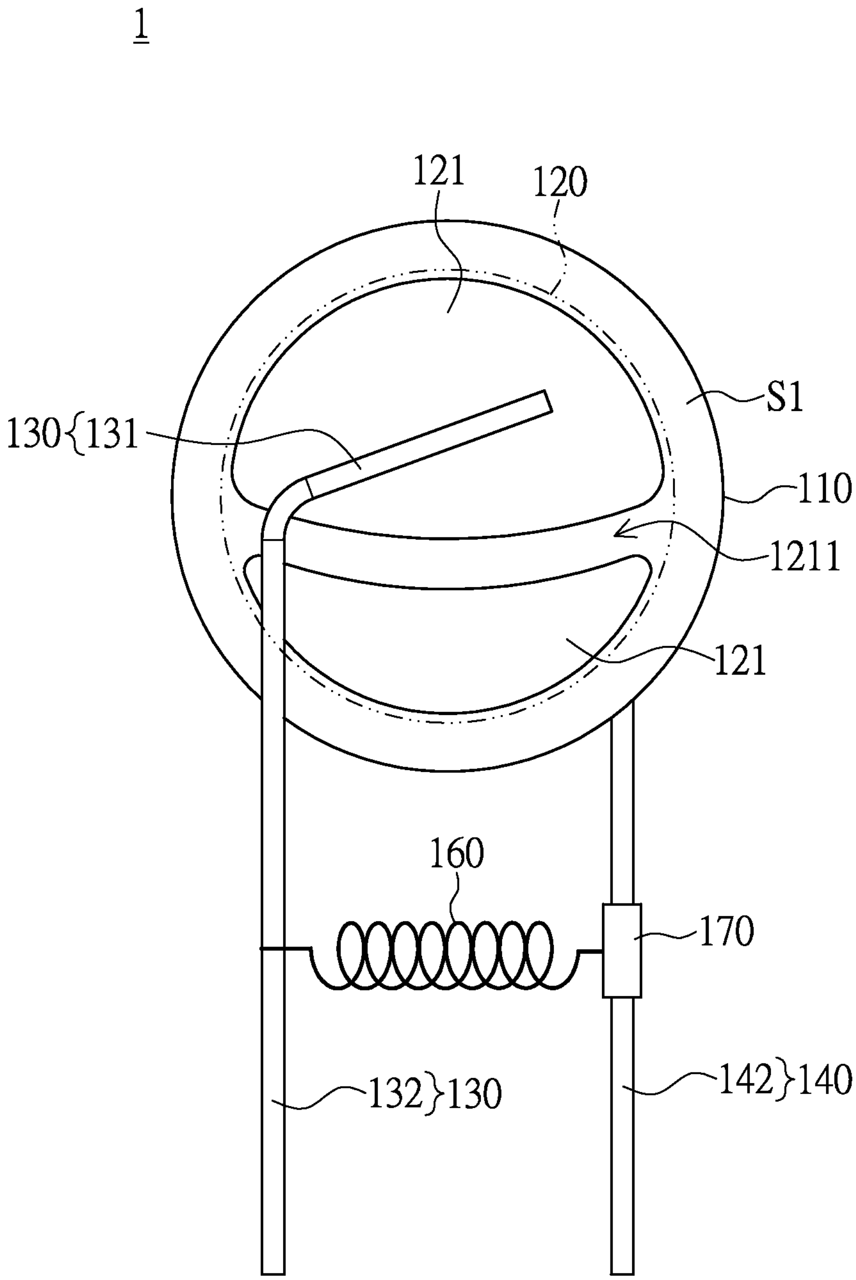

FIG.4

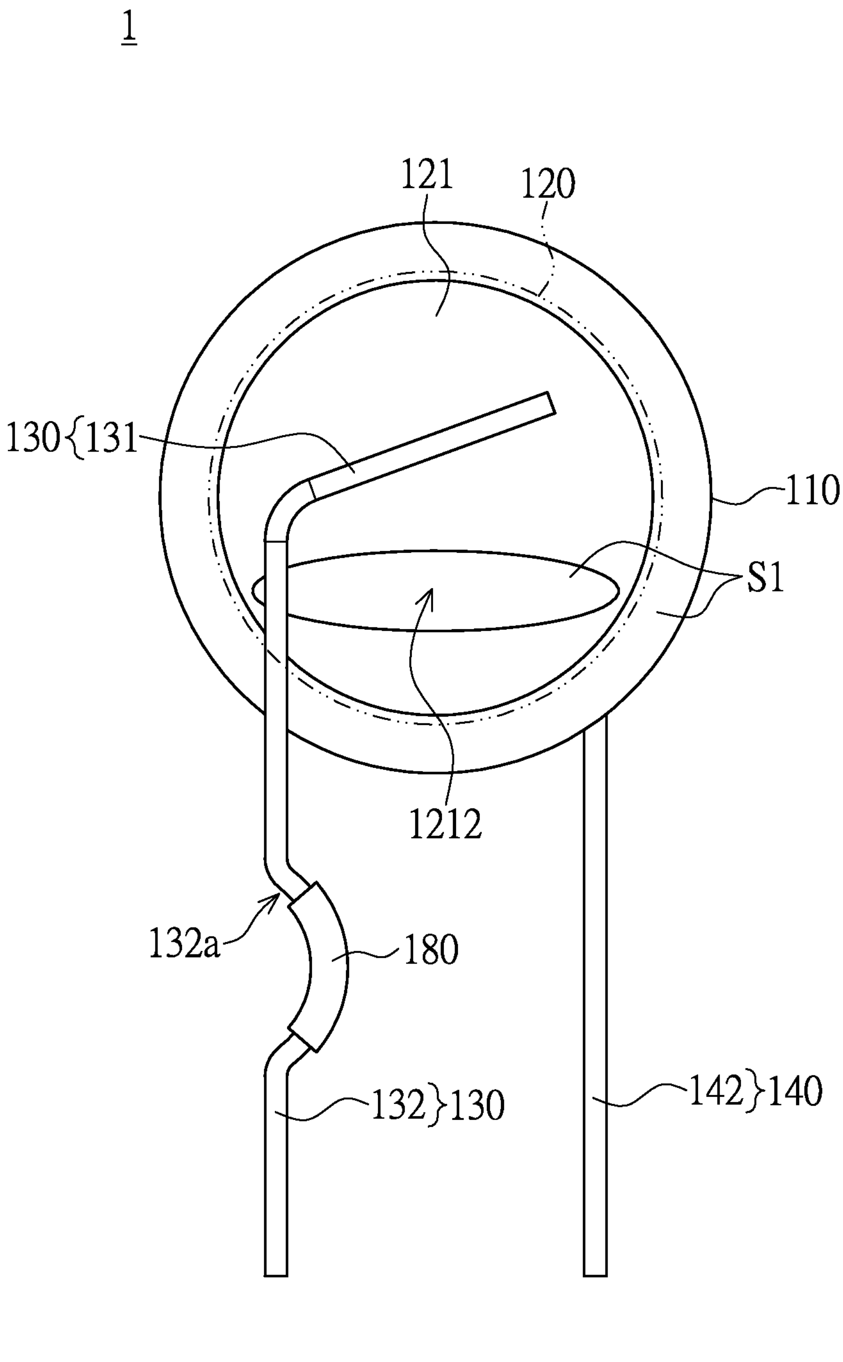

FIG.5A

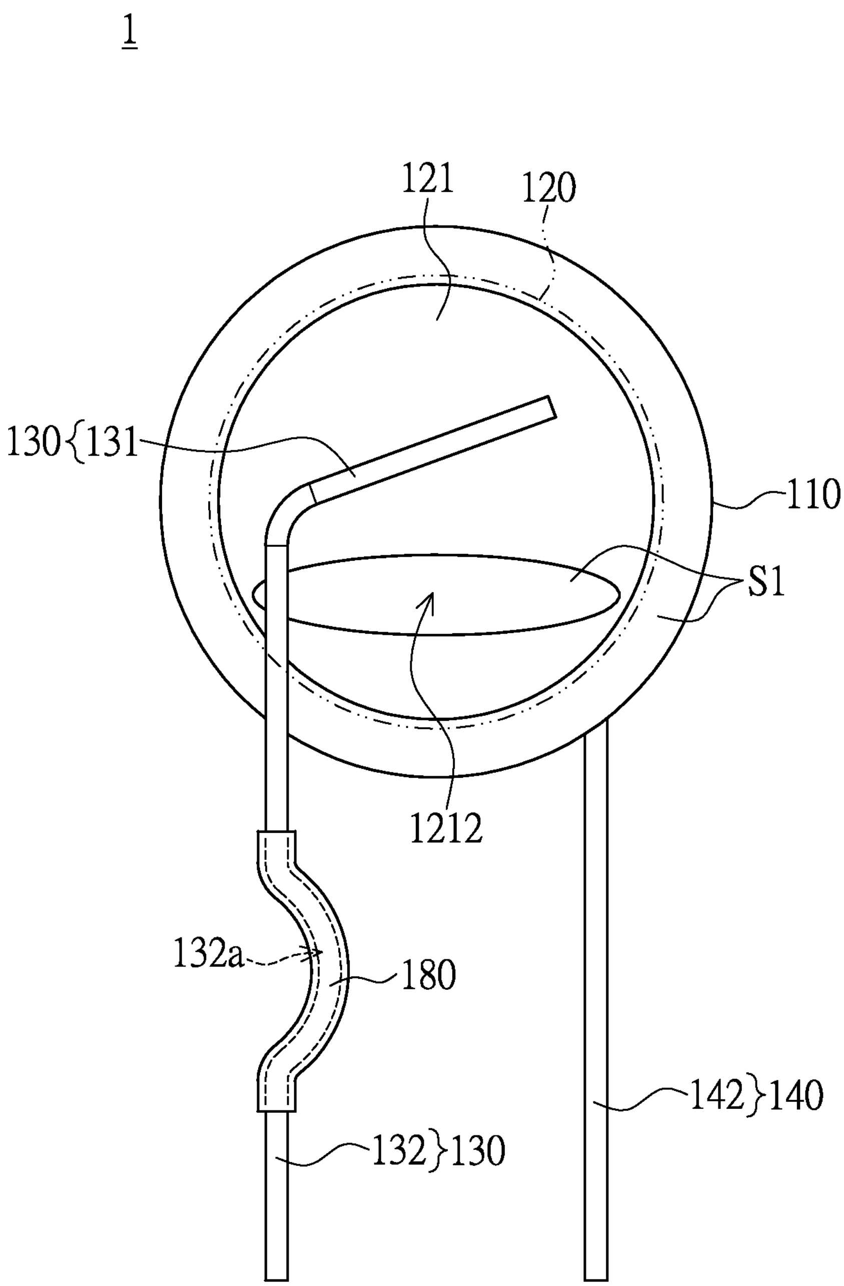

FIG.5B

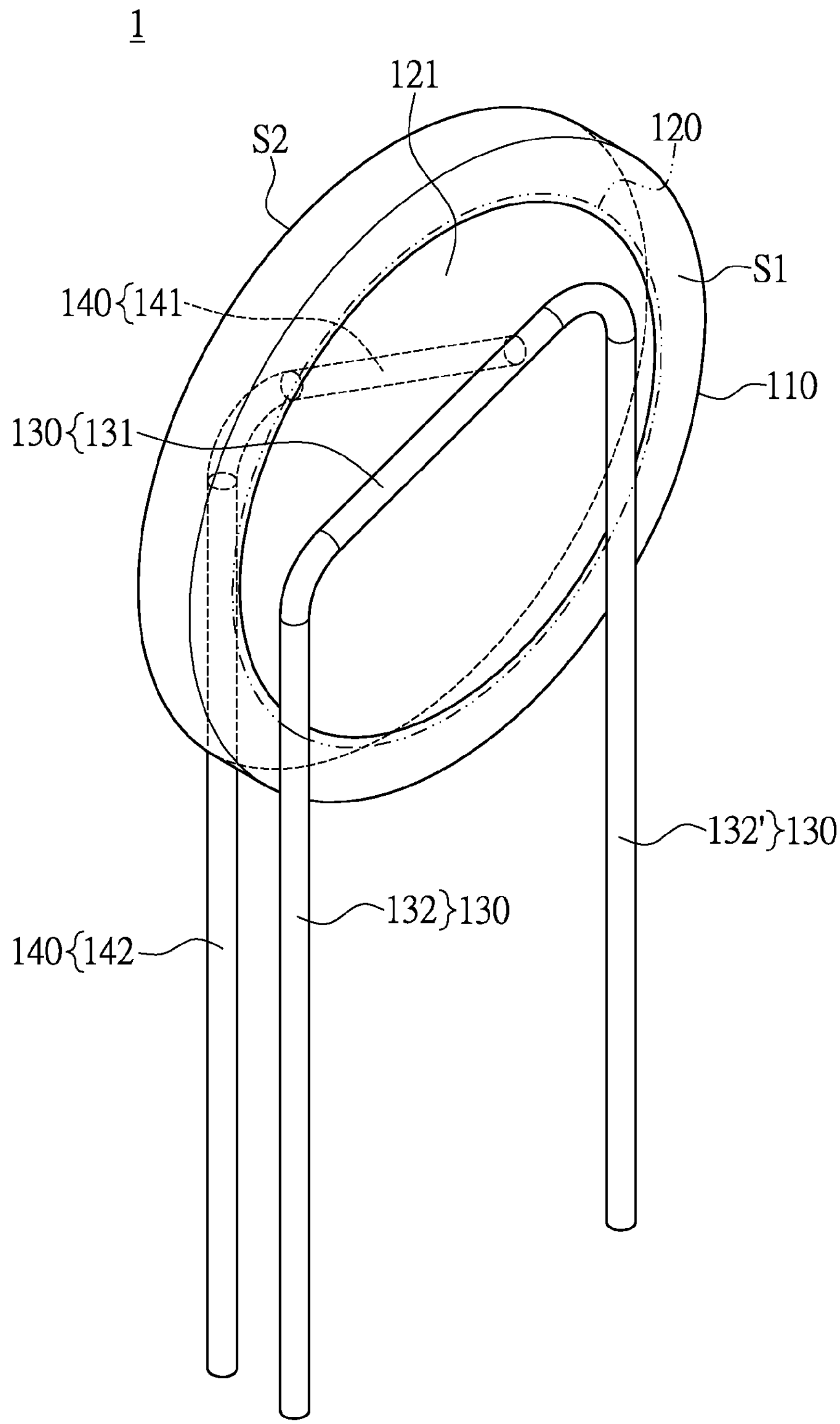

FIG.6A

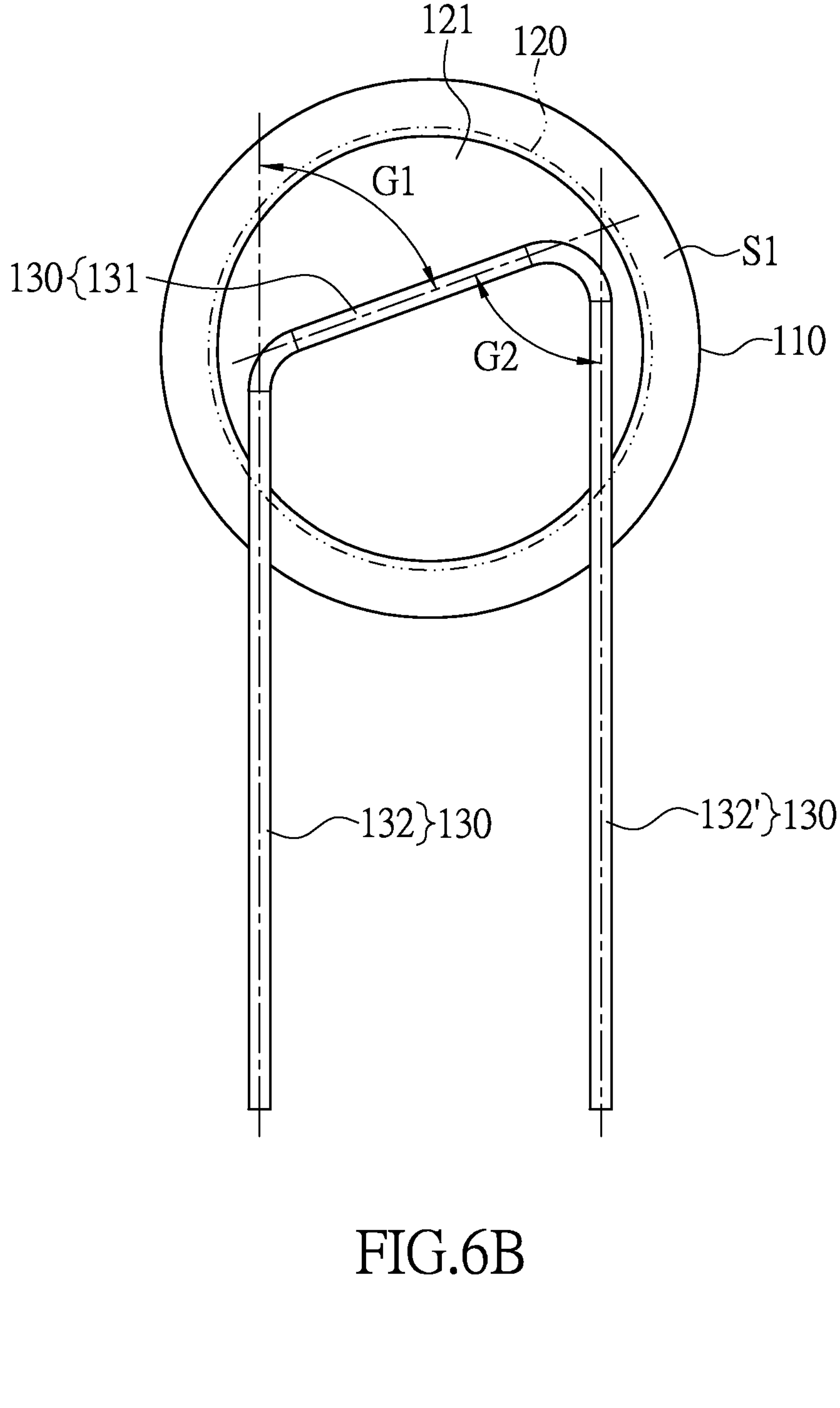

FIG.6B

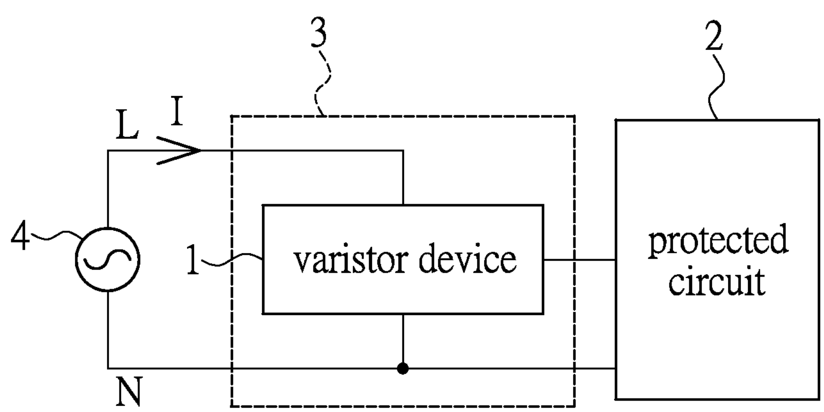

FIG.7

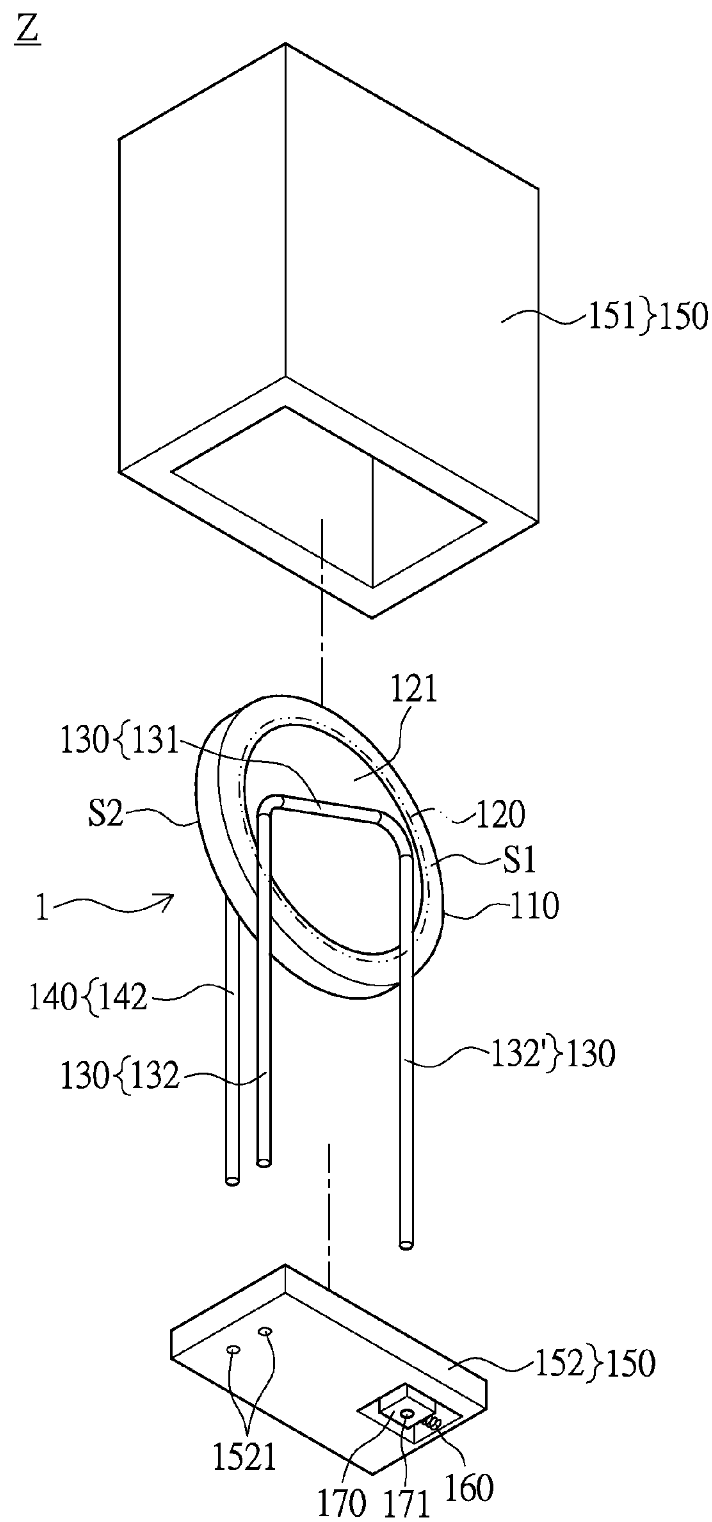
Z
151}150
121
130{131
S2
120
S1
1
110
140{142
132'}130
130{132
152}150
1521
170
171
160

FIG.8

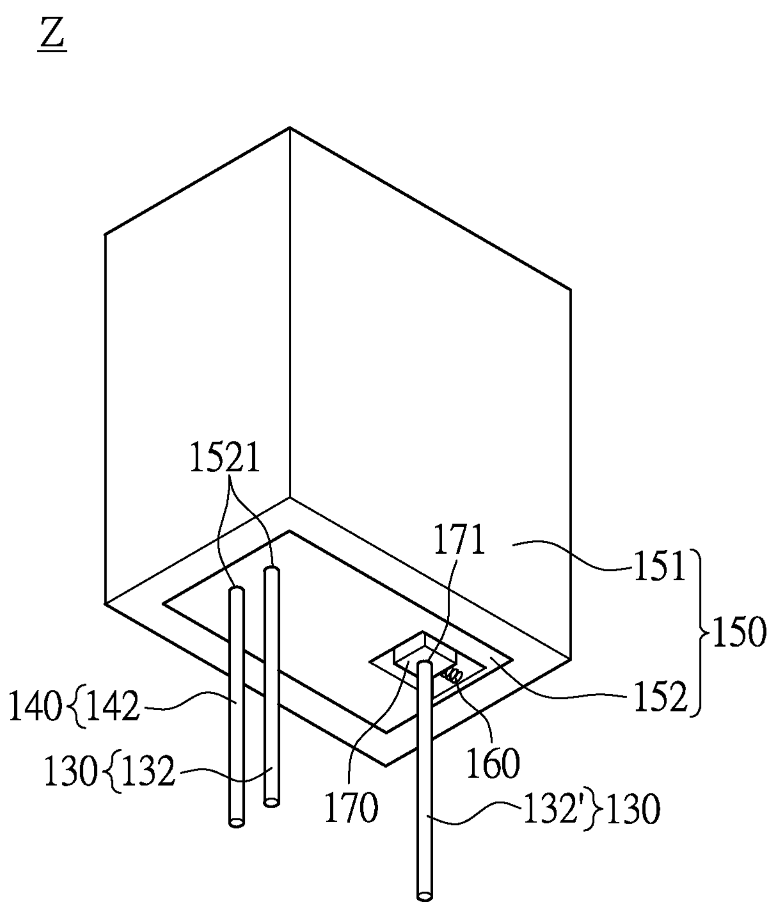

FIG.9

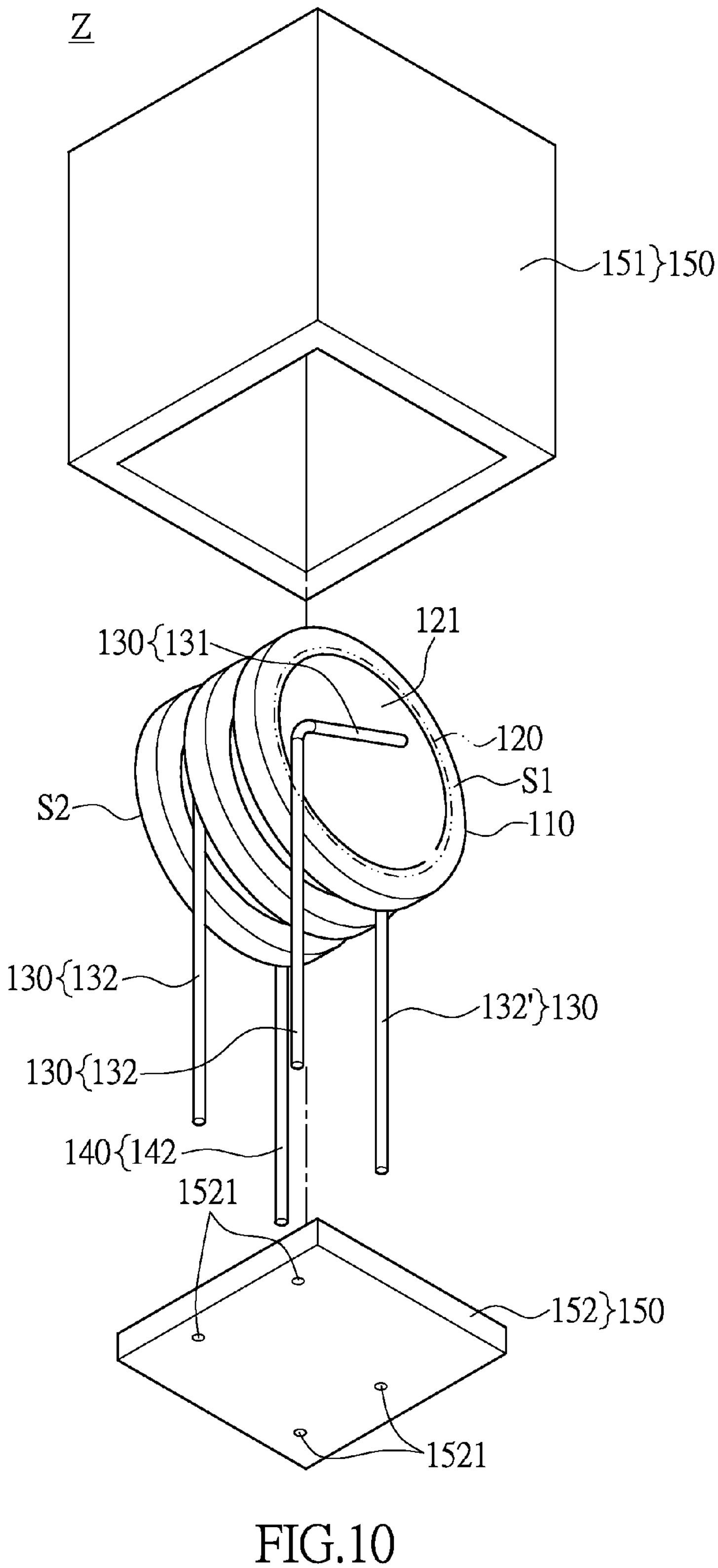
Z
151}150
130{131
121
120
S1
S2
110
130{132
132'}130
130{132
140{142
1521
152}150
1521

FIG.10

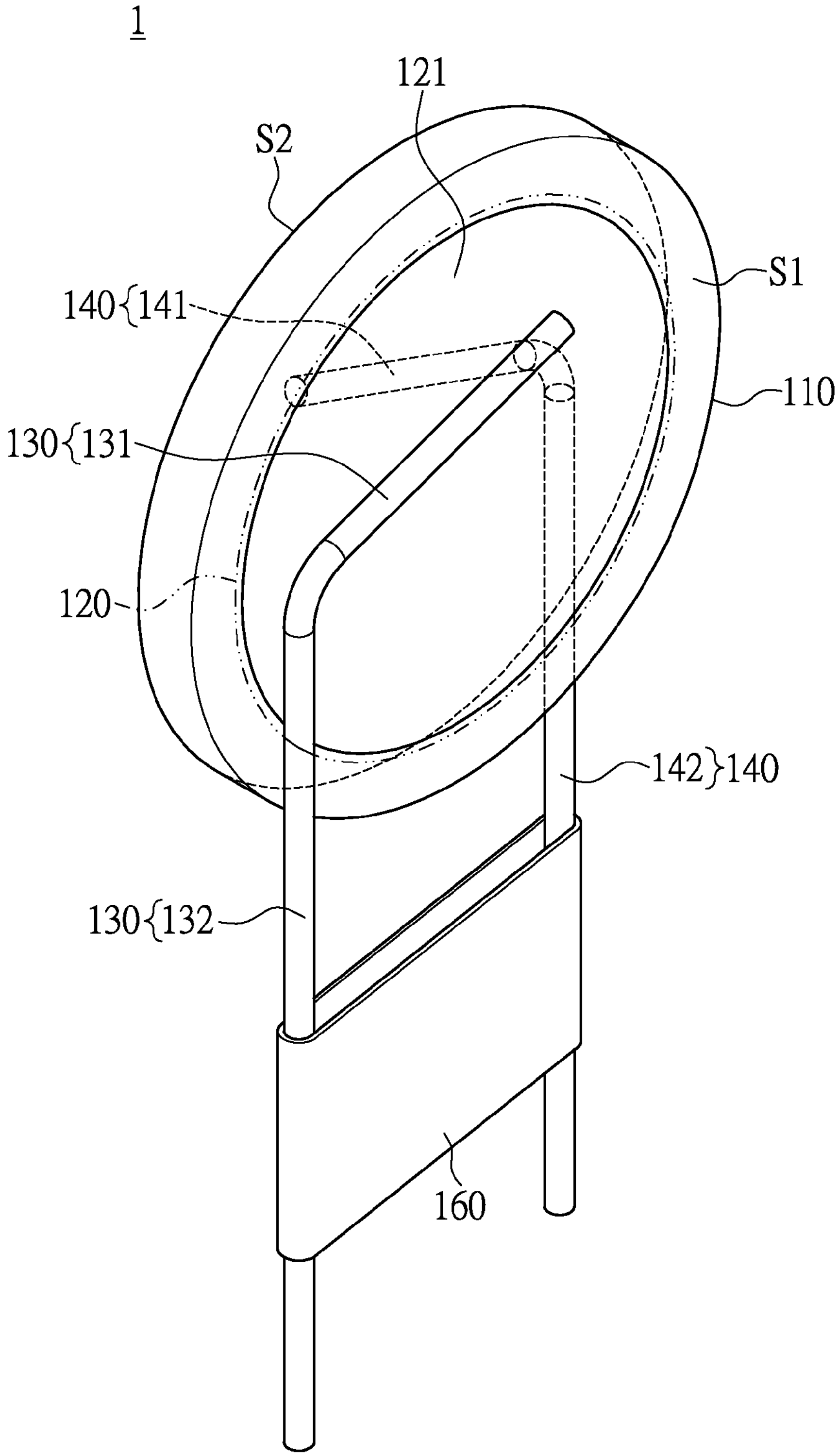

FIG.11

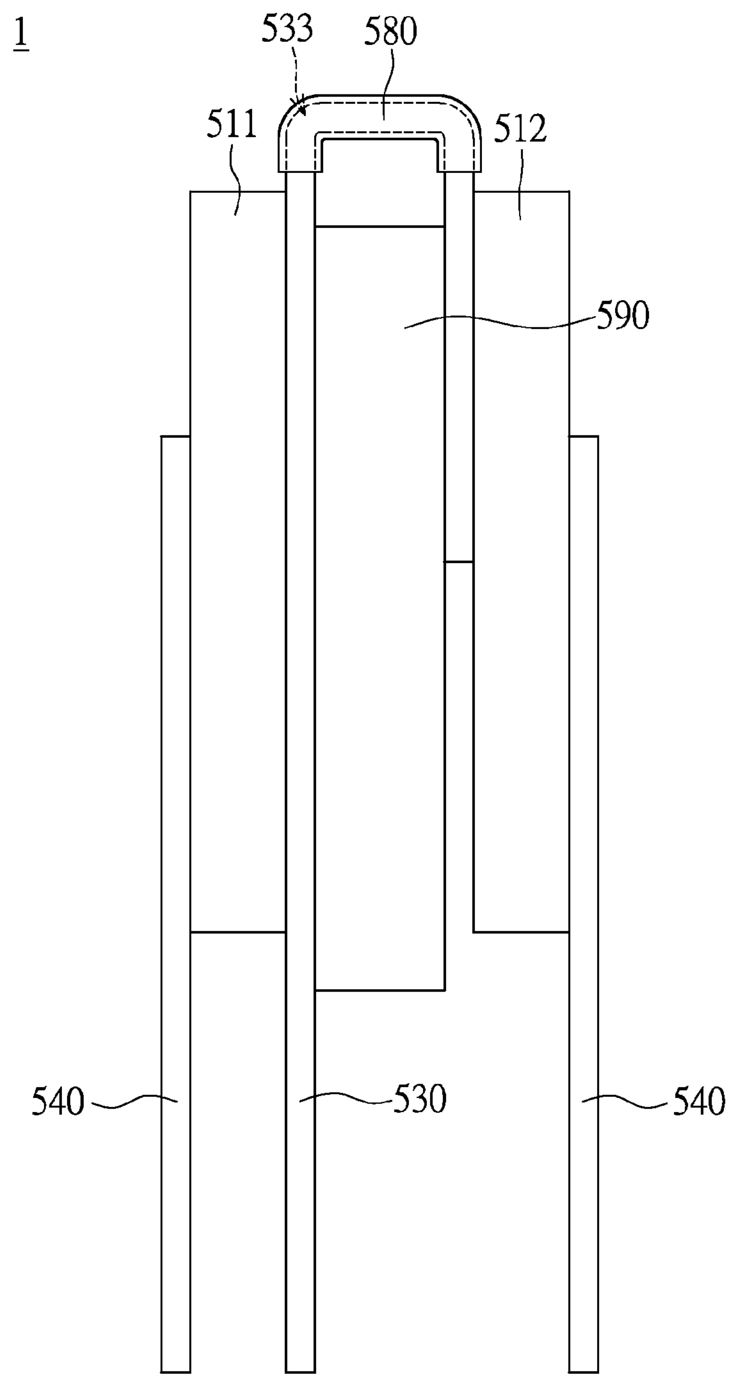

FIG.12

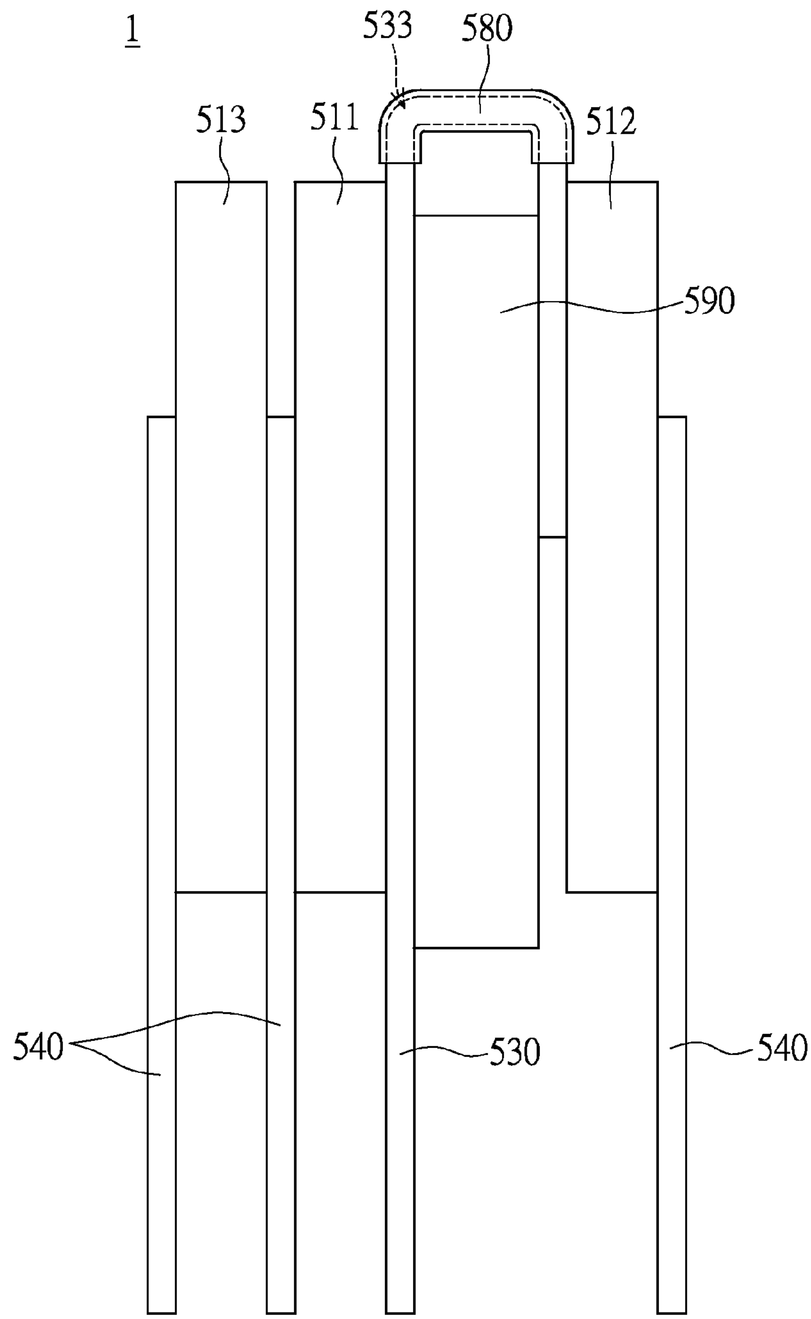

FIG.13

VARISTOR DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present disclosure relates to a varistor device; in particular, to a varistor device having a specific-melting-point metallic pin.

2. Description of Related Art

Varistors are used as control or compensation elements in circuits either to provide optimal operating conditions or to protect against excessive transient voltages. When used as protection devices, they shunt the current created by the excessive voltage away from sensitive components when triggered. The most common type of varistor is the metal-oxide varistor (MOV). Application of sustained over-voltage to a varistor can cause high dissipation, potentially resulting in the varistor catching fire. A series connected thermal fuse is one solution to varistor failure. However, dissipated heat may degrade the varistor and reduce its life expectancy, and a user may have no indication when the surge suppressor has failed. Furthermore, if the melting point of the thermal fuse is greater than a temperature that would cause the varistor to burst into flames, the varistor may burst into flames before the melting thermal fuse breaks in two to cut off the conducted current; or, the flaming of the varistor and the breaking of thermal fuse may occur at the same time.

As a specific example, the metal oxide varistor disclosed in U.S. Pat. No. 7,453,681 utilizes a fuse to cut off the over-voltages. However, in the heat protection structure of the metal oxide varistor that will automatically go to open circuit in conditions of overheating, the fuse has to be electrically connected between the body and one of the terminals through solder joints. Therefore, the heat may not be able to be conducted to the fuse quickly due to the multiple solder joints, and the heat-shrinkable element wrapped securely around the fuse may not be able to be timely subjected to heat. On the other hand, an insulation bracket is needed to increase the thermal conduction, whereby the heat may be able to be conducted to the fuse more quickly. However, the size and the arrangement of the insulation bracket disposed on the varistor are limited by the size of the varistor, and the insulation bracket may increase the size of the device.

SUMMARY OF THE INVENTION

The present disclosure provides a varistor device, which includes a main body, a conductive area, a specific-melting-point metallic pin, and an elastic unit. The main body has a first surface, and the conductive area is located at the first surface. The specific-melting-point metallic pin has a first section and a second section. The first section and the second section are one-piece formed. The first section is fixedly disposed on the conductive area. The second section has a specific melting point such that the second section melts when a current flows between the first surface and the second section as to expose the second section to a temperature greater than the specific melting point. The elastic unit has an end connected to the second section, and the elastic unit provides an elastic force to the second section to break the second section so as to cut off the current when the second section melts.

The present disclosure also provides a varistor device, which includes a first main body, a second main body, a spacing piece, and a metallic pin. The first main body and the second main body are stacked with each other. The

spacing piece is interposed between the first main body and the second main body. The metallic pin is interposed between the first main body and the second main body and bypasses the spacing piece. The metallic pin has an end extending outwardly from a side of the first main body, and the metallic pin has another end bypassing the spacing piece and fixedly disposed on the second main body.

In order to further the understanding regarding the present disclosure, the following embodiments are provided along with illustrations to facilitate the disclosure of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a perspective view of a varistor device according to a first embodiment of the present disclosure;

FIG. **2** shows a plan view of the varistor device of FIG. **1**;

FIG. **3** shows a circuit block diagram of a protecting circuit where the varistor device of FIG. **1** is applied;

FIG. **4** shows a plan view of the varistor device according to a second embodiment of the present disclosure;

FIG. **5**A and FIG. **5**B each show a plan view of the varistor device according to a third embodiment of the present disclosure;

FIG. **6**A shows a perspective view of the varistor device according to a fourth embodiment of the present disclosure;

FIG. **6**B shows a plan view of the varistor device of FIG. **6**A;

FIG. **7** shows a circuit block diagram of the protecting circuit where the varistor device of FIG. **6**A is applied;

FIG. **8** shows an exploded view of the varistor device according to a fifth embodiment of the present disclosure;

FIG. **9** shows a perspective view of the varistor device of FIG. **8**;

FIG. **10** shows an exploded view of the varistor device according to a sixth embodiment of the present disclosure;

FIG. **11** shows a perspective view of the varistor device according to a seventh embodiment of the present disclosure;

FIG. **12** shows a perspective view of the varistor device according to an eighth embodiment of the present disclosure; and

FIG. **13** shows a perspective view of the varistor device according to a ninth embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The aforementioned illustrations and following detailed descriptions are exemplary for the purpose of further explaining the scope of the present disclosure. Other objectives and advantages related to the present disclosure will be illustrated in the subsequent descriptions and appended drawings.

First Embodiment of Varistor Device

Please refer to FIG. **1** and FIG. **2**. FIG. **1** shows a perspective view of a varistor device according to a first embodiment of the present disclosure. FIG. **2** shows a plan view of the varistor device of FIG. **1**.

The embodiment provides a varistor device **1**, which includes a main body **110** having a first surface S**1**, a conductive area **120**, a specific-melting-point metallic pin **130**, and an elastic unit **160**. The conductive area **120** is located at the first surface S**1** of the main body **110**. The specific-melting-point metallic pin **130** includes a first section **131** fixedly disposed on the conductive area **120** and a second section **132** having a specific melting point. The first section **131** and the second section **132** are one-piece formed. When a current I flows between the first surface **S1** and the second section **132** so as to expose the second section **132** to a temperature greater than the specific melting point, the second section **132** melts. The elastic unit **160** has an end connected to the second diction **132** and provides an elastic force to the second section **132** to break the second section **132** when the second section **132** melts, as to cut off the current I.

To put it concretely, the main body **110** further has a second surface **S2** opposite to the first surface **S1**. The first surface **S1** and the second surface **S2** each serve as an electrode face, which is used for being connected to a corresponding external conductive pin. In the present embodiment, the main body **110** is disc-shaped. As a specific example, the main body **110** can be elongated, annular, or have an irregular shape. The main body **110** has a preferred clamping voltage, thus to suppress line voltage surges. For example, the main body **110** can be made of a metal-oxide ceramic material with an electrical resistivity that varies with the applied voltage, such as strontium titanate (SrTiO3), silicon carbide (SiC), zinc oxide (ZnO), iron oxide (Fe2O3), tin oxide (SnO2), titanium dioxide (TiO2) and barium titanate (BaTiO3) and the like.

The conductive area **120** is located at the first surface **S1** of the main body **110**. The conductive area **120** may have a covering layer **121** covering the first surface **S1** and in direct touch with the first surface **S1**. For example, as shown in FIG. **2**, the covering layer **121** partially covers the first surface **S1**, and particularly, the covering layer **121** covers the central portion of the first surface **S1** such that the conductive area **120** having a roughly circular shape is formed. The shape of the conductive area **120** can be designed according to need. As a specific example, the shape of the conductive area **120** may be oval, triangular, or hexagonal, and the present disclosure is not limited thereto. The covering layer **121** may be formed by physical vapor deposition (PVD) or chemical vapor deposition (CVD). The covering layer **121**, for example, is formed of a conductive material including tin dioxide (SnO2), silver (Ag), silver/palladium (Ag/Pd), aluminum (Al), nickel (Ni), copper (Cu), titanium (Ti), tantalum (Ta), tungsten (W), silicon carbide (SiC), silver/platinum (Ag/Pt), titanium dioxide (TiO2), and the like. In another embodiment, the covering layer **121** may cover the entire first surface **S1**.

The specific-melting-point metallic pin **130** includes the first section **131** and the second section **132**. The first section **131** and the second section **132** are one-piece formed. The first section **131** is fixedly disposed on the conductive area **120**, and the second section **132** extends outwardly from the conductive area **120**. The specific-melting-point metallic pin **130** can be positioned between the first surface **S1** and the covering layer **121**. Alternatively, the covering layer **121** can be formed between the specific-melting-point metallic pin **130** and the first surface **S1**. As shown in FIG. **2**, the shape of the specific-melting-point metallic pin **130** resembles the shape of an "L", and the extension direction of the first section **131** and the extension direction of the second section **132** form an angle G, which substantially ranges from 45 degrees to 90 degrees. The extension direction of the first section **131** and the extension direction of the second section **132** each are substantially parallel with the first surface **S1**. The shape of the specific-melting-point metallic pin **130** can be designed according to need, and the present disclosure is not limited thereto.

The specific-melting-point metallic pin **130** is formed of a specific-melting-point metallic material, and the second section **132** has the specific melting point. The specific melting point of the second section **132** ranges from a melting point of a soldering material to a melting point of the main body **110**. In other words, the specific melting point of the second section **132** can be greater than the melting point of a soldering material, and less than the melting point of the main body **110**. As a specific example, the specific-melting-point metallic pin **130** is formed of a material including a primary metal selected from the group consisting of aluminum, lead, zinc, tin, and any combination thereof. In the instant disclosure, the specific melting point of the second section **132**, for example, ranges from 150 to 700 Celsius degrees. The first section **131** can be fixedly disposed on the electrode area **120** by carrying out an inserting and soldering process on the main body **110**, such that the first section **131** and the covering layer **121** are configured to be in electrical connection, whereby the specific-melting-point metallic pin **130** may serve as a conductive pin of the main body **110** for external connection. It is worth mentioning that, the first section **131** and the second section **132** are one-piece formed of the specific-melting-point metallic material, and the second section is not confined within the electrode area **120**, as shown in FIG. **2**.

The varistor device **1** further includes a conductive pin **140** having a first section **141** and a second section **142**. The first section **141** of the conductive pin **140** is fixedly disposed on the second surface **S2** of the main body **110**, and the second section **142** of the conductive pin **140** extends outwardly from the main body **110**. As shown in FIG. **2**, the shape of the conductive pin **140** resembles the shape of an "L", and the extension direction of the conductive pin **140** is substantially parallel with the second surface **S2**. The shape of the conductive pin **140** shown in FIG. **2** is exemplary, and the present disclosure is not limited thereto. The first section **141** can be fixedly disposed on the second surface **S2** by carrying out an inserting and soldering process on the main body **110**, such that the first section **141** and the main body **110** are configured to be in electrical connection, whereby the conductive pin **140** may serve as a conductive pin of the main body **110** for external connection. The conductive pin **140** can be a specific-melting-point metallic pin, and alternatively, the conductive pin **140** may not be a specific-melting-point metallic pin. In another embodiment, the varistor device **1** may include a plurality of specific-melting-point metallic pins **130**, and one of the specific-melting-point metallic pins **130** serves as a conductive pin of the varistor device **1**. In other words, the conductive pin **140** can be formed of the specific-melting-point metallic material, and the conductive pin **140** can have a specific melting point.

Please refer to FIG. **3**, which shows a circuit block diagram of a protecting circuit where the varistor device of FIG. **1** is applied. The varistor device **1** can be applied in a protecting circuit **3**. The protecting circuit **3** may contain only the varistor device **1**, which is in parallel connection with a power source **4** and a protected circuit **3** for forming an electronic circuit. The power source **4** can provide power to the protected circuit **2** via the power-input wires, such as the live wire L and the neutral wire N. In an exemplary application, the varistor of the present embodiment can be disposed on a printed circuit and used as a protection device for suppressing line voltage surges. To put it concretely, the second section **132** of the specific-melting-point metallic pins **130** is electrically connected to the live wire L of the power source **4** and a power-input terminal of the protected circuit **2**, and the second section **142** of the conductive pin **140** is electrically connected to the neutral wire N of the power source **4** and the power-input terminal of the protected circuit **2**.

Specifically, the second section **132** of the specific-melting-point metallic pins **130** is in electrical connection to the printed circuit board through a first contacting spot, which can be a filler metal, such as a golden ball, a silver ball, a lead ball, or the like, soldered on the second section **132** or the printed circuit board. The second section **142** of the conductive pin **140** is in electrical connection to the printed circuit board through a second contacting spot, which can be a filler metal, such as a golden ball, a silver ball, a lead ball, or the like, soldered on the second section **142** or the printed circuit board. The protecting circuit **3** and the electrical connection of the protecting circuit **3** and the protected circuit **4** are exemplary, and the varistor device **1** can also be applied in a socket device or an electronic device.

Moreover, the second section **132** extending outwardly from the main body **110** can serve as a first supporting pin of the main body **110**, and the second section **142** extending outwardly from the main body **110** can serve as a second supporting pin of the main body **110**. Furthermore, the second section **132** and second section **142** each have a determined mechanical strength, such that the specific-melting-point metallic pin **130** and the conductive pin **140** each can withstand the weight of the main body **110** for holding the main body **110** at a determined position. For example, after the varistor device **1** is disposed on the circuit board, the specific-melting-point metallic pin **130** and the conductive pin **140** each can be used to hold the main body **110** at a determined position above the circuit board. It is worth noting that, the specific-melting-point metallic pin **130** alone can withstand the weight of the main body **110** for supporting the main body **110**.

In another embodiment, the specific-melting-point metallic pin **130** or the conductive pin **140** does not serve as a supporting pin. For example, the specific-melting-point metallic pin **130** or the conductive pin **140** does not have the determined mechanical strength for supporting the main body **110**. The shape, the size, the material, the strength, or the position of the specific-melting-point metallic pin **130** can be designed according to need, and the present disclosure is not limited thereto in the instant embodiment.

The elastic unit **160** is formed of an elastic material. As a specific example, the elastic unit **160** can be a linear spring, rubber, or the like. The elastic unit **160** has an end connected to the second section **132** of the specific-melting-point metallic pin **130**. The elastic unit **160** provides an elastic force to the second section **132**. For example, the elastic unit **160** is extended and deformed so as to provide the elastic force to the second section **132**. As a specific example shown in the Figures, the direction of the elastic force provided to the second section **132** is substantially perpendicular to the extension direction of the second section **132**, and the present disclosure is not limited thereto. In another embodiment, the direction of the elastic force provided to the second section **132** and the extension direction of the second section **132** can be parallel with each other.

When a current I flows between the first surface S1 and the second section **132** as to expose the second section **132** to a temperature greater than the specific melting point, at least a portion of the second section **132** melts. In applications, the varistor device **1** can be used to conduct a current I, which flows through the conductive pin **140**, the main body **110**, and the specific-melting-point metallic pin **130** for suppressing voltage surges. However, an oxide material is easily formed on the surface of the specific-melting-point metallic pin **130** that is exposed to air. Without providing any external force, the melting second section **132** of the specific-melting-point metallic pin **13** may not break in two due to the oxide material formed on the surface of the second section **132**.

When the second section **132** is exposed to a temperature greater than the specific melting point, the elastic unit **160** can break the melting second section **132**, which has the oxide material formed on the surface thereof, by the elastic force provided to the second section **132** so as to cut off the current I, resulting in the opening of the varistor **1**. The second section **132** broken by the elastic unit remains discontinuous, thus preventing the varistor device **1** from heating up or catching fire.

On the other hand, the temperature of the main body **110** rises when the varistor device **1** is subjected to voltage surges, and the temperature of the specific-melting-point metallic pin **130** rises by thermal conduction due to a temperature gradient. When the temperature of the specific-melting-point metallic pin **130** is greater than the specific melting point, the elastic **160** unit breaks the melting second section **132** in two so as to cut off the current I. Since the specific melting point of the second section **132** is less than a temperature of the varistor device **1** that causes flames, the varistor device **1** can be cut off and become electrically discontinuous before bursting into flames, which prevents the electronic devices arranged in proximity to the varistor device **1** from being damaged by the flame.

The relative positions of the abovementioned components can be altered according to needs. The following describes other embodiments of varistor devices according to the present disclosure. It must be noted that components which can be similar to those of the above embodiment are not further described.

Second Embodiment of Varistor Device

Please refer to FIG. **4**, which shows a plan view of the varistor device according to a second embodiment of the present disclosure. As shown in FIG. **4**, the covering layer **121** disposed within the electrode area **120** partially covers the first surface S1 and has a pattern. Specifically, the covering layer **121** has an opening **1211**. The portion of the first surface S1 of the main body **110** that is corresponding to the opening **1211** is exposed and not covered by the covering layer **121**. As a specific example, the opening **1211** of the covering layer **121** has an elongated shape. The first section **131** is fixedly disposed on the electrode area **120**, and the second section **132** extends outwardly from the electrode area **120**. When the first section **131** melts and breaks in two, the second section **132** and the covering layer **121** are still in electrical connection and the current I is not cut off.

The elastic unit **160** has an end connected to the second section **132** and another end fixedly disposed on the second section **142** of the conductive pin **140**, whereby the space needed for disposing the elastic unit **160** can be saved for minimizing the varistor device **1**. Moreover, the elastic unit **160** is fixedly disposed on the second section **142** through an insulating unit **170**, such that the elastic unit **160** is electrically insulated from the conductive pin **140**.

Third Embodiment of Varistor Device

Please refer to FIG. **5**A and FIG. **5**B. FIG. **5**A and FIG. **5**B each show a plan view of the varistor device according to a third embodiment of the present disclosure. As shown in FIG. **5**A and FIG. **5**B, the covering layer **121** disposed within the electrode area **120** partially covers the first surface S**1** and has a pattern. Specifically, the covering layer **121** has an aperture **1212**, which is located within the electrode area **120**. The portion of the first surface S**1** of the main body **110** that is corresponding to the aperture **1212** is exposed and not covered by the covering layer **121**. Furthermore, the covering layer **121** encloses the portion of the first surface S**1** that is corresponding to the aperture **1212**. The first section **131** is fixedly disposed on the electrode area **120**, and the second section **132** extends outwardly from the electrode area **120**.

The second section **132** has a bent portion **132***a*. The shape of the bent portion **132***a* resembles the shape of a "c" letter or an inversed "c" letter. The varistor device **1** of the present embodiment does not have any elastic unit **160** (FIG. **1**). Instead, the varistor device **1** may include a heat-shrink tubing **180**. The heat-shrink tubing **180** sleeves the bent portion **132***a* and is heat shrinkable. When subjected to heat, the heat-shrink tubing **180** is shrunk to wrap tightly around the bent portion **132***a* and provide a tension force on the other portion of the second section **132** that is not sleeved by the heat-shrink tubing **180**, as to break the melting second section **132**, whereby the current I is cut off. The operating temperature of the heat-shrink tubing **180** for shrinking can be greater than the specific melting point of the second section **132**. In the instant disclosure, the second section **132** has merely a single bent portion **132***a*. In another embodiment, the second section **132** can have at least two single bent portions **132***a*, and the number of the heat-shrink tubing **180** can correspond to the number of the bent portions **132***a*. The number or the position of the bent portion **132***a* shown in FIG. **5**A and FIG. **5**B is exemplary, and the present disclosure is not limited thereto. Furthermore, the heat-shrink tubing **180** can further sleeve the portion of the second section **132** that is in proximity to the bent portion **132***a*, such as the portion of the second section **132** that extends upwardly or downwardly from the bent portion **132***a*.

Fourth Embodiment of Varistor Device

Please refer to FIG. **6**A, FIG. **6**B, and FIG. **7**. FIG. **6**A shows a perspective view of the varistor device according to a fourth embodiment of the present disclosure. FIG. **6**B shows a plan view of the varistor device of FIG. **6**A. FIG. **7** shows a circuit block diagram of the protecting circuit where the varistor device of FIG. **6**A is applied. The specific-melting-point pin **130** of the varistor device **1** according to the instant embodiment has two second sections **132**, **132'**. When a current I flows between the first surface S**1** and the second section **132** or **132'** so as to expose the second section **132** or **132'** to a temperature greater than the specific melting point, at least a portion of the second section **132** or **132'** melts.

To put it concretely, the shape of the specific-melting-point pin **130**, for example, resembles the shape of a "∩". The two second sections **132**, **132'** are positioned side by side. The extension direction of the first section **131** and the extension direction of the second section **132** form an angle G**1**, which ranges from 45 to 90 degrees. The extension direction of the first section **131** and the extension direction of the second section **132'** form an angle G**2**, which ranges from 45 to 90 degrees. The extension directions of the first section **131** and the second section **132**, **132'** are substantially in parallel with the first surface S**1**. As a specific example, the specific-melting-point pin **130** can be formed of a cylindrical metal strip having a low melting point through bending over one or more times.

Fifth Embodiment of Varistor Device

Please refer to FIG. **8** and FIG. **9**. FIG. **8** shows an exploded view of the varistor device according to a fifth embodiment of the present disclosure. FIG. **9** shows a perspective view of the varistor device of FIG. **8**. The varistor device Z of the instant embodiment further includes a hosing **150** disposed outside the main body **110** and housing the main body **110**. The housing **150** has a melting point greater than the specific melting point of the second section **132**, **132'**, whereby the temperature can be blocked inside the housing **150**.

Specifically, the housing **150** includes an upper cover **151** and a bottom cover **152**, and the bottom cover **152** is formed with a plurality of through-holes **1521**. The through-holes **1521** correspond to the second sections **132**, **132'** of the specific-melting-point metallic pin **130** and the second section **142** of the conductive pin **140** respectively. The second sections **132**, **132'** and the second section **142** each pass through the corresponding through-hole **1521** and extend outwardly from the bottom cover **152**, such that parts of the second sections **132**, **132'** and the second section **142** are exposed outside the housing **150**. In another embodiment, the second sections **132**, **132'** and the second section **142** each can be completely exposed outside the housing **150**.

The varistor device Z may include two elastic units **160** respectively connected to the second sections **132**, **132'**. The arrangements, the relative positions, and the operations of each of the elastic units **160**, the insulating units **170**, and the abovementioned components are similar to those of the above embodiment. In FIG. **8** and FIG. **9**, only one of the two elastic units **160** is illustrated to facilitate the explanation of the present embodiment. As shown in FIG. **8** and FIG. **9**, the elastic unit **160** has a first end connected to the second section **132'**. Specifically, the first end of the elastic unit **160** is connected to the second section **132'** through the insulating unit **170**. Moreover, the elastic unit **160** has a second end fixedly disposed on the housing **150**. For example, the elastic unit **160** can be accommodated in the bottom cover **152**, whereby the extension or compression of the elastic unit **160** can be confined within the bottom cover **152**. The insulating unit **170** is formed with a through-hole **171**, and the insulating unit **170** sleeves the second section **132'** by the through-hole **171**, such that the insulating unit **170** is connected to the second section **132'**. The second end of the elastic unit **160** is fixedly disposed on the bottom cover **152**. In another embodiment, the second end of the elastic unit **160** can be fixedly disposed on the upper cover **151**.

Sixth Embodiment of Varistor Device

Please refer to FIG. **10**, which shows an exploded view of the varistor device according to a sixth embodiment of the present disclosure. A plurality of the abovementioned varistor devices **1** can be electrically connected to one another in series, in parallel, or a combination thereof. When one of the varistor devices **1** receives an excessive voltage, the varistor devices **1** receiving the excessive voltage will be in a short-circuit state to shunt the current, protecting against excessive transient voltages. In the instant embodiment as shown in FIG. **10**, three of the abovementioned varistor devices **1** are electrically connected to one another in series.

The three varistor devices each include a main body **110**, a conductive area **120**, and a specific-melting-point metallic pin **130**, and one of the three varistor devices further includes a conductive pin **140**.

Seventh Embodiment of Varistor Device

Please refer to FIG. **11**, which shows a perspective view of the varistor device according to a seventh embodiment of the present disclosure. As shown in FIG. **11**, the elastic unit **160** is formed with a heat-shrink material peripherally arranged around and connected to the second section **132** of the specific-melting-point metallic pin **130** and the second section **142** of the conductive pin **140**, to sleeve and hold the second section **132** and the second section **142**. When subjected to heat, the elastic unit **160** is shrunk to wrap tightly around the second section **132** and the second section **142** and provide a tension force to break the melting second section **132**, whereby the current I is cut off. The elastic unit **160** can be sheet-like as shown in FIG. **11**. In another embodiment, the elastic unit **160** can be banded or sleeve-like, and the present disclosure is not limited thereto.

Eighth Embodiment of Varistor Device

Please refer to FIG. **12**, which shows a perspective view of the varistor device according to an eighth embodiment of the present disclosure. As shown in FIG. **12**, the varistor device **1** includes at least two main bodies **511**, **512** stacked with each other, a spacing piece **590**, and a metallic pin **530**. The spacing piece **590** is interposed between the main bodies **511**, **512** for blocking the heat conducting there between. Therefore, when one of the main bodies **511**, **512** receives excessive transient voltages, the dissipated heat is not easily conducted to the other of the main bodies **511**, **512**. The spacing piece **590** protects one of the main bodies **511**, **512** against heat conducted from the other of the bodies **511**, **512** due to excessive transient voltages.

The metallic pin **530** bypasses the spacing piece **590**. The metallic pin **530** is interposed between the two main bodies **511**, **512** and in touch with both the two main bodies **511**, **512**. The metallic pin **530** has an end extending outwardly from a side of the main body **511**, and the metallic pin **530** has another end bypassing the spacing piece **590** and fixedly disposed on the main body **512**, whereby the two main bodies **511**, **512** are electrically connected to each other in series or in parallel through the metallic pin **530**. For example, the metallic pin **530** has a bent section **533**, and the metallic pin **533** can bypass the spacing piece **590** through the bent section **533** to be connected between the two main bodies **511**, **512**. As a specific example, the shape of the bent section **533** resembles the shape of "∩", and the metallic pin **530** can hold the spacing piece **590**. In another embodiment, the metallic pin **533** can bypass the spacing piece **590** through the bent section **533**, such that, in the direction of thickness of the main body **511**, **512**, the spacing piece **590** is in touch with both the two main bodies **511**, **512**, and the metallic pin **530** is also in touch with both the two main bodies **511**, **512**. The metallic pin **530** can be formed of the abovementioned specific-melting-point metallic material, and the bent section can have a specific melting point, which ranges from a melting point of a soldering material to a melting point of the main body **511**, **512**. Moreover, the varistor device **1** further includes a heat-shrink unit **580**, which sleeves the bent section **533**. As a specific example, the heat-shrink unit **580** can sleeve the entire bent section **533**. When a current I flows in the metallic pin **530** so as to expose the bent section **533** to a temperature greater than the specific melting point of the bent section **533**, the bent section **533** melts. When subjected to heat, the heat-shrink unit **580** is shrunk to wrap tightly around the bent section **533** and provide a tension force on the other portions of the metallic pin **530** that are not sleeved by the heat-shrink unit **580**, so as to break the melting bent section **533**, whereby the current I is cut off thus to prevent the varistor device **1** from heating up or catching fire.

The varistor device **1** further includes at least one conductive pin **540**. As shown in FIG. **12**, the varistor device **1** may include two conductive pins **540**. One of the conductive pins **540** and the metallic pin **530** are positioned at two opposite sides of the main body **511** respectively, and the other of the conductive pins **540** and the metallic pin **530** are positioned at two opposite sides of the main body **512** respectively. It is worth noting that, the metallic pin **530** can be formed of various metallic materials having electrical conductivity, and the bent section **533** of the metallic pin **530** may not have the abovementioned specific melting point. In another embodiment, the varistor device **1** may not have any of the conductive pins **540** or the heat-shrink unit **580**.

Ninth Embodiment of Varistor Device

Please refer to FIG. **13**, which shows a perspective view of the varistor device according to a ninth embodiment of the present disclosure. As shown in FIG. **13**, the varistor device **1** includes three main bodies **511**, **512**, and **513** stacked with one another, a spacing piece **590**, a metallic pin **530**, a heat-shrink unit **580**, and three conductive pins **540**. The three main bodies **511**, **512**, and **513** are electrically connected to one another in series. Specifically, the main bodies **511**, **512** are electrically connected to each other through the metallic pin **530**, and the main bodies **512**, **513** are electrically connected to each other through one of the conductive pins **540**.

To sum up, in accordance with the embodiments, the abovementioned varistor device **1** utilizes the specific-melting-point metallic pin **130** and the elastic unit **160** to cut off the current I when subjected to excessive heat, thus to prevent the varistor device **1** from heating up or catching fire. Especially, when the second section **132**, **132'** of the specific-melting-point metallic pin **130** is exposed to a temperature greater than the specific melting point thereof, the second section **132**, **132'** can melt and the elastic unit **160** can break the melting second section **132**, **132'** in two so as to cut off the current I. Therefore, the varistor device **1** can become electrically discontinuous and not burst into flames.

The descriptions illustrated supra set forth simply the preferred embodiments of the present disclosure; however, the characteristics of the present disclosure are by no means restricted thereto. All changes, alterations, or modifications conveniently considered by those skilled in the art are deemed to be encompassed within the scope of the present disclosure delineated by the following claims.

What is claimed is:

1. A varistor device, comprising:

a main body having a first surface;

a conductive area located at the first surface;

a specific-melting-point metallic pin having a first section and a second section, wherein the first section and the second section are one-piece formed, the first section is fixedly disposed on the conductive area, the second section has a specific melting point such that the second section melts when a current flows between the first surface and the second section as to expose the second section to a temperature greater than the specific melting point; and

an elastic unit having an end connected to the second section, wherein the elastic unit provides an elastic force to the second section to break the second section as to cut off the current when the second section melts.

2. The varistor device according to claim **1**, wherein the specific melting point ranges from a melting point of a soldering material to a melting point of the main body.

3. The varistor device according to claim **1**, wherein the specific-melting-point metallic pin is formed of a material including a primary metal selected from the group consisting of aluminum, lead, zinc, tin, and any combination thereof.

4. The varistor device according to claim **1**, wherein the conductive area has a covering layer covering the first surface, the covering layer is formed of a material including silver and has a pattern, and the second section extends outwardly from the conductive area and serves as a first supporting pin of the main body.

5. The varistor device according to claim **1**, further comprising a conductive pin having a first section and a second section, the first section of the conductive pin is fixedly disposed on a second surface of the main body, the second section of the conductive pin extends outwardly from the main body and serves as a second supporting pin of the main body, the elastic unit has another end fixedly disposed on the second section of the conductive pin and electrically insulated from the conductive pin.

6. The varistor device according to claim **1**, further comprising a housing, wherein the housing houses the main body and has a melting point greater than the specific melting point, and the elastic unit has another end fixedly disposed on the housing.

7. A varistor device, comprising:

a main body having a first surface;

a conductive area located at the first surface; and

a specific-melting-point metallic pin having a first section and a second section, wherein the first section and the second section are one-piece formed, the first section is fixedly disposed on the conductive area, the second section has a specific melting point such that the second section melts when a current flows between the first surface and the second section as to expose the second section to a temperature greater than the specific melting point; and an elastic unit, wherein the elastic unit provides an elastic force to the metallic pin.

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